§7. The Variation of Poloidal Rotation on the Magnetic Surfaces in CHS Plasmas

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The spectroscopic measurements of plasma rotation are widely used to estimate radial electric fields. Radial electric field and rotation velocity are determined by the gradient of electrostatic potential and ion pressure, which are considered to be surface quantities, and thus have variation along the magnetic surfaces depending on the surface configuration. However, the detection of this variation (in other words, the experimental proof that indicates that the electrostatic potential is the surface quantity) have never been done. For this purpose, the poloidal rotation measurement using the bidirectional observation of charge exchange spectral lines[1] is being carried out in CHS.

Figure 1 and Figure 2 show the example of the Doppler shifts of CVI line(Δ n=8-7, λ =5292 Å) at the vertically elongated section. In inward shifted and low-β configurations, the gradients of surface function ($|d\Psi/dR|$ at Z=0 plane) on the inner side and the outer side of the section are symmetric, and thus the poloidal rotation velocities on both sides are also symmetric. On the contrary, the poloidal rotation velocities on both sides become asymmetric according to the inner/outer asymmetry of $|d\Psi/dR|$, in outward shifted and/or high-β configuration. The electrostatic potential at Z=0 plane calculated from this asymmetric poloidal rotation velocity in outward shifted configuration is shown in Figure 3. The dependence of the potential on averaged minor radius ρ has inner/outer symmetry, therefore the asymmetry of the rotation velocity of C^{6+} ions is the consequence of the potential which is the surface quantity.

On the other hand, the strong parallel viscosity in Heliotron/Torsatron[2] reduces the parallel ion flow which is necessary to form incompressible flow conservation when this kind of poloidal ion flow exists in low aspect ratio tori. To investigate this flow conservation, the estimation of C^{6+} ion density profile using the intensity of charge exchange excited spectral line is being done now.

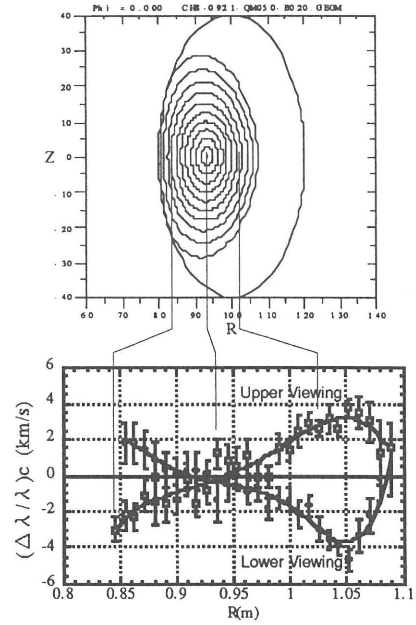

Fig.1 Doppler shifts in the configuration of Rax=93.5cm

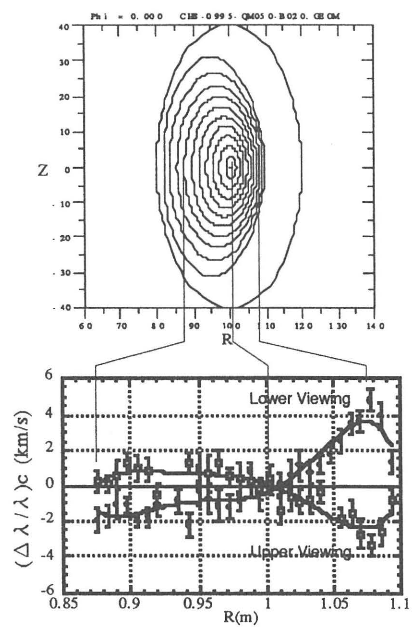

Fig.2 Doppler shifts in the configuration of Rax=99.5cm

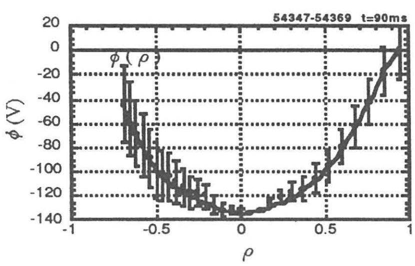

Fig.3 Electrostatic potential in the case of Rax=99.5cm

References

1) Nishimura,S., et.al.;Ann.Rep.NIFS(1996)p.239
2) Ida,K., et.al.;Phys.Rev.Lett.67 (1991) 58.